

THE UK NATIONAL ECOSYSTEM ASSESSMENT: PRACTITIONER'S PERSPECTIVE

Sustainable forest management in a time of ecosystem services frameworks: common ground and consequences

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Key-words: Decision-making, forestry, land use, multiple benefits, policy, UK Forestry Standard, valuation, woodlands

Introduction

The Millennium Ecosystem Assessment has stimulated much interest in the linkages between the state of ecosystems and human well-being, and resulted in a number of international and national initiatives. For example, the UK National Ecosystem Assessment (UKNEA) is being widely discussed in research and land use policy communities, and has already influenced domestic policy (UK National Ecosystem Assessment 2011). The philosophy of ecosystem services is thought by many ecologists to be a good thing, leading to an expectation that their preferred landscapes or habitats will be conserved and that new resources will emerge to underpin and secure wider environmental benefits. Others are interested in particular markets that might develop the opportunities for new business enterprises and the new funding that might make land management more profitable.

Our practitioners' view stems from involvement in British forestry and in particular in the application of ecological research to the policy, planning and management of woodlands and forests. In the practitioner world, we inhabit, a common question is:

How does the framework of ecosystem services compare with the prevailing one of sustainable forest management? Or, more prosaically, as a senior forest manager recently put it: What the heck is it all about?

We reflect on the common ground and consider possible consequences for forestry and sustainable forest management of incorporating an ecosystem services approach.

Our first perspective is that there is confusion around terminology and concepts. Many discussants appear to miss the subtle differences and use concepts from ecosystem services framework, an ecosystem approach, and sustainable forest management seamlessly and interchangeably. As a basis for our perspective, we start, therefore, with brief

definitions. The ecosystem approach is considered to be 'a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way' (Secretariat of the Convention on Biological Diversity (CBD) 2004). The Ministerial Conference on the Protection of Forests in Europe (MCPFE) adopted a definition for sustainable forest management as 'The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality, and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national and global levels, and that does not cause damage to other ecosystems' (Helsinki Ministerial Conference 1993). The UKNEA suggested that 'Ecosystem services are the benefits provided by ecosystems that contribute to making human life possible and worth living' and that 'The adoption of an ecosystems approach yields a requirement for an evidence base on ecosystem change and ecosystem service provision to inform decision-making'. Furthermore, the UKNEA sees change in ecosystems as a result of direct and indirect drivers and that, by understanding the important contribution to human well-being, a variety of societal responses may be adopted which lead to further change and possible improvements in ecosystems and their services. It is this operationalising of ecosystem services through the establishment of values and identification of societal responses which we consider as the ecosystem services framework. As a basis for our perspective, we now summarise sustainable forest management, making selective observations using the language of ecosystem services.

Sustainable forest management in Britain

The stewardship of forest ecosystems in Britain up to the start of the twentieth century was lamentable. The post-glacial restoration of vegetation cover and a possible woodland cover of greater than 70% were subject to the ravages of agriculture, industry, climate and wild and

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domestic ungulates such that only 5% of woodland cover remained. The loss was buffered by imports from a forest-rich empire, but the vulnerability of this supply was apparent during both the first and second world wars. The policy response was to develop a strategic reserve of timber, establish the Forestry Commission in 1919 to oversee this task and initiate a substantial afforestation programme, primarily with fast-growing exotic coniferous species, through state and private planting. The focus on strategic reserve continued to the 1950s with consequences on landscapes and ecosystems that have attracted much comment from ecologists and others (e.g. Tsouvalis 2000). The success of the policy in enhancing provisioning (and as a by-product also regulating) ecosystem services is highlighted in woodland, timber and carbon statistics (Quine *et al.* 2011). For example, UK woodland cover has increased to 13% by 2011, and domestic supply now accounts for approximately 20% of consumption of pulp, paper and timber rather than 4% in 1945.

During the latter half of twentieth century, a series of legislative and policy changes shifted the goal for forestry away from simply provisioning services towards a mix of ecosystem services and from blanket afforestation to maintenance of a balance of land uses. These shifts were, in part, responses to concern over impacts of new conifer forests on cultural landscapes, on designated species and open habitats and the relevance of a strategic reserve in a nuclear age. Opportunities became evident for enhanced public good from a land use which did not offer high rates of financial return. The shift was described initially as multi-purpose forestry reflecting the trade-off between production and other benefits, although commercial benefit remained an important element for many enterprises. Ecologists shaped practice by encouraging the conservation and planting of native broadleaves (e.g. Peterken 1981), as realised in the 1985 Broadleaves policy and subsequent guidance (e.g. Rodwell & Patterson 1994); by arguing against further expansion of conifer forests in upland England and in the Flow Country (e.g. Stroud *et al.* 1987), leading to tax changes in 1988; and by highlighting the value of ancient woodland (e.g. Spencer & Kirby 1992), leading to stronger protection of ancient remnants and removal of plantations on ancient woodland sites. Many interventions reflected specific concerns over particular species or habitats and not necessarily ecosystem functioning or the provision of multiple ecosystem services.

The emergence of sustainable forest management initiated further policy change in Britain, as elsewhere. In Europe, it was aligned to the concept of the ecosystem approach by the MCPFE and within the Pan European Biological and Landscape Diversity Strategy. The EU Forestry Strategy (Council Resolution 1999/C 56/01) explicitly recognises the multifunctional role of forests for society and supports Member State implementation of sustainable forest management through domestic forest policies. Multi-purpose forestry was modified to require

explicit consideration of environmental, economic and social objectives. This, together with responses to the threat of climate change through mitigation and adaptation (Read 2009), has been the focus of subsequent policy development. The United Kingdom Forestry Standard (UKFS) was developed in 1998 to articulate the basis for sustainable forest management and provide a framework for the pursuit of multiple benefits, whilst minimising consequences on other environmental qualities both within and outside the forest boundary. The third edition of the UKFS (Forestry Commission 2011) describes seven sets of supporting guidelines (biodiversity, climate change, historical environment, landscape, people, soil, water) which together contain 39 legal requirements, 59 requirements of good forestry practice and 316 elements for sustainable forest management.

The character of woodlands and resultant mix of ecosystem services are determined by the long-term interaction between policy and linked delivery mechanisms, management reflecting the owner's objectives and the environment. Although twentieth century expansion of woodland was driven by strategic and commercial interests, woodlands in the UK are owned by a wide diversity of owners (with only 29% owned by the forest service), with diverse objectives. Government agencies have sought to encourage and enforce the principles of sustainable forest management through mechanisms encompassing the three categories of response options recently identified in the UKNEA – namely foundational (such as research), enabling (such as legislation and the UKFS) and instrumental (such as public forests, grant aid, and encouragement of markets).

Approval of operations and payment of grants (e.g. for enhanced public access; nature conservation; protection of watercourses) depend upon conformity to the UKFS. Voluntary certification reinforces these standards and provides additional benefits of access to markets. The UK Woodland Assurance Standard is a certification standard, independent of the UKFS, aligned with the Forest Stewardship Council and the Programme for the Endorsement of Forest Certification. Forest design plans provide an expression of the intended balance of benefits, the means of achievement and the basis for stakeholder engagement. The plan considers the context of forests (spatial, temporal and economic), productive potential and possible markets (both timber and non-timber forest products), the landscape qualities and the presence of features of high ecological value and multiple (although typically long) time-scales including the choice of species of trees to provide resilience. The long time-scales necessitate a degree of flexibility in the plan, enabling adaptive management to new opportunities, evidence, markets and the changing climate.

The development of sustainable forest management in the UK can be considered a domestic and sectoral approach to the CBD and sustainability challenge, achieved in dialogue with others such as the water indus-

try, nature conservation bodies and increasingly local communities. A variety of mechanisms seek to secure multiple benefits. These are not explicitly quantified or monetised but are a form of evolved compromise, balancing many interests at various scales in the face of imperfect information. Encouraging the implementation of the standards (whether UKFS or voluntary certification) remains challenging given the large but unknown number of woodland owners, and the fragmented nature of the woodland resource. This is particularly marked in England where there may be more than 60 000 woodland owners, 40% of woodland in private ownership is comprised of woods less than 10 ha in size and only 36% of private woodland is 'actively managed' if assessed by a criteria of known to be managed according to UKFS.

Towards common ground

There is common ground between the framework of ecosystem services and that of sustainable forest management. In particular, both acknowledge the dependency of human well-being on receipt of multiple benefits from the environment and aspire to a holistic view spanning multiple spatial and temporal scales. Both recognise the need for policy and management choices to be made in order to achieve synergies and reduce harmful trade-offs, and seek mechanisms which encourage balanced delivery of both private and public benefits. Finally, both need more evidence to underpin choices than is currently available, whilst using an expert language and abstract concepts that are challenging for the lay person and practitioner.

Nevertheless, there appears to be two important differences that challenge co-application of the two frameworks. First, the ecosystem services framework adopts a more explicit focus on valuation, and particularly economic valuation, prior to policy and management

decisions. In contrast, sustainable forest management operates an evolved compromise between multiple interests with supporting mechanisms to encourage public benefits. Second, sustainable forest management focuses more systematically on land management and on discrete spatial parcels at multiple scales (e.g. national forest cover, forest or catchment, coupe) that are mappable, largely visible and related to land ownership. In contrast, the ecosystems concept is harder to bound and less visible albeit more accurately reflecting the multiscale and integrative nature of the environment.

Consequences

There is a momentum behind use of an ecosystem services framework which will impact upon the concept of sustainable forest management and shape wider land use policy. What might be the consequences given the differences in approach and emphasis? We discuss advantages, disadvantages and uncertainties under three themes (Table 1).

A MOVE AWAY FROM A SECTORAL APPROACH

The integrative approach of ecosystem services is likely to facilitate discussions between sectors and land uses, with advantages emerging from use of the same language (even if it is dense to the uninitiated).

New markets may also emerge for ecosystem services that are not confined to a single sector or land use; indeed, some such as carbon may be global in reach. Forestry remains uncompetitive compared with agriculture, particularly when the latter is subsidised through mechanisms such as the EU Common Agricultural Policy. Profitability is low, so there is keen interest in new forms of finance that would reward woodland owners for

Table 1. Summary of perceived impacts from the incorporation of ecosystem services thinking into sustainable forest management (SFM)

Advantages	Disadvantages	Uncertainties
A. A common language across land uses and sectors	E. Valuation may be very incomplete and push attention towards services which are readily quantified and monetised	H. How lack of knowledge of many services and their interactions will be accommodated in decision-making?
B. New money – sources of finance and markets	F. Challenges the evolved compromise of SFM where synergies have been encouraged without full quantification	I. How adaptive management can continue when faced with long-term legal commitments to particular services?
C. Encourages an integrated approach with other land uses (more explicit focus on trade-offs and synergies)	G. Emerging markets (for single quantifiable services) may discourage types of woodland (and even the presence of woodland) that provides multiple benefits	J. Scale is less explicit and so may be harder for practitioners and decision-makers to implement?
D. Multiple service provision of existing forests (of all types) more widely acknowledged/credited	H. Challenges the acceptability of constraints within existing environmental regulations	K. Implications for conservation designations of focussing more on functional biodiversity?

ecosystem services whilst not necessarily relying on the public purse. New mechanisms will be needed to underpin delivery of services across land ownerships and between land uses to provide a desirable mix. New markets such as for carbon sequestration and storage might introduce binding agreements which reinforce the supply of services over many decades. This could provide some much needed stability in long-term environmental management and reduce the impact of fickle policy changes.

A greater emphasis on ecosystem services might encourage some reassessment of the benefits of forestry as a land use. Arguably, in the UK, a focus on narrow cultural constraints has distracted from the multiple benefits of restoring forest cover. For example, the negative perception of Sitka spruce *Picea sitchensis* because of its association with land use change, non-native status and closely spaced young stands contrasts with evidence that it does support biodiversity (Quine & Humphrey 2010), fulfils many regulating and provisioning services, and can be managed to provide an environment well suited to some leisure pursuits. Management for longer rotations (e.g. as carbon store rather than for timber) or by introducing additional tree species and adopting less intensive silvicultural regimes will enhance the structure of these stands and add to the aesthetic and biodiversity quality. However, such reassessment needs to be carefully framed and will be context-specific (e.g. Schlaepfer, Sax & Olden 2011 and subsequent comments). It should consider potential disbenefits, including those beyond the forest boundary, taking account of experience in other countries of the invasiveness of tree species selected for commercial forestry (Essl *et al.* 2010).

A CHALLENGE TO THE COMPROMISE

Will an ecosystem services approach challenge the evolved compromise of sustainable forest management? Some are concerned that 'money will talk' so that services with clear market values (e.g. biomass, carbon) are pursued by land managers at the expense of those for which quantification and monetisation are not yet possible (e.g. pollination, biodiversity, shared social value). It seems likely that markets for different services will emerge at different rates, and this may not provide the holistic approach to delivery of multiple ecosystem services sought by some proponents. It is arguable that new financed markets may weaken ideas of stewardship and the co-production of a range of services, instead emphasising the efficient production of single services for which there is a payment. This would strain adherence to the voluntary agreements that have evolved and might necessitate further regulation for environmental protection. For example, current forest design guidelines emphasise the need for inclusion of open space, riparian zones, appropriate treatment of forest margins for visual amenity and diversification of tree species; they are a requirement for grant aid and voluntary certification. Each has an impact upon production of

biomass or carbon and could be viewed as undesirable by a market that has more leverage than grant aid and only pays for such products. However, mechanisms such as bundling of services may prevent an excessive focus on just a few (Deal, Cochrane & LaRocco 2012).

Discussion of trade-offs and synergies within the UK National Ecosystem Assessment (2011) largely focussed on those within a single broad habitat, but these will need to occur both within and between ecosystems. Often there are a large number of different services that could potentially be provided on the same tract of land, and preferred solutions may differ between those reflecting the objectives of the owner, the views of local communities, and desirable land use balance within regions. It seems possible that land use conflicts could arise as proponents of particular ecosystem services pursue parcels of land for which others have different priorities. For example, there is controversy in the UK over the appropriate location for woodland expansion (whether for carbon sequestration or restoration of native ecosystems) in the face of competing demands for food security and for maintenance of open habitats for species conservation. Land use strategies have some way to go before guiding such interactions.

HOW WILL IT WORK IN PRACTICE?

There are substantial uncertainties over what the co-application of ecosystem services and sustainable forest management might mean on the ground. In particular, at what scale will decisions be prioritised and how will they accommodate incomplete valuation? Will lack of evidence breed excessive precaution or shift the focus on only those services that are evidenced?

Managing for ecosystem services will likely adopt a variety of measures and mechanisms, but flexibility for adaptive management may be reduced if land is 'committed' at the planning stage to provide specific services. The spatial unit for decision-making may no longer fit with forest management units, and the consequences of constraining scale of ecosystem to an unit need to be understood. The varied time-lags between habitat creation, or restoration and service provision are an added complication. For example, carbon sequestration by broadleaved woodland will begin within 5–10 years of planting, but landscape, recreation and biodiversity values may take several decades to emerge and all span longer than typically addressed by policy and incentive schemes.

Current legislation and forestry mechanisms in the UK protects many cultural values (rare species, priority habitats), and is structured to respond to obligations to European Directives, but largely without considering functioning of ecosystems. This is not necessarily compatible with an ecosystem service approach, in which it is the goods or services that become the end points, not the condition of a habitat or conservation status, or welfare of individuals of an European Protected Species. There is

potential for conflict between conservation instruments and legal or financial arrangements for securing service delivery.

Conclusions

How to answer our puzzled forest managers? There are many common threads between the principles of sustainable forest management and the framework of ecosystem services. Both emphasise interactions between the environment and human well-being, and our dependency upon its maintenance and on sustainability. Woodlands, even those managed primarily for timber production, can provide multiple benefits. So, forest managers may be reassured (partially) to know that they have been delivering ecosystem services and operating within a form of ecosystem services framework – without necessarily knowing it! There are undoubtedly consequences for forest management from the burgeoning interest in ecosystem services. As discussed previously, some but not all are positive and there is much uncertainty.

Ecologists have rightly applauded the emergence of an ecosystem services framework as supporting a wider perspective of value of nature, and particularly to new audiences including politicians and industrialists. However, the approach is not without risk, and there do seem to be dangers if markets develop selectively and do not adequately address multiple benefits. There are concerns that what is hard to value may lose out; it would be ironic if pursuit of ecosystem services (e.g. carbon) led to a return to pursuit of the single purpose forests akin to those used to re-establish the strategic reserve in the UK. Similarly, the opportunities for adaptive management, a sensible strategy in times of environmental and climatic change, may be constrained if market mechanisms are restrictive. Pressure could be placed on the evolved compromise currently underpinning the practice of sustainable forest management, and which has been influenced and shaped by considerable input from ecologists.

To address these concerns, we have four recommendations. First that more attention is given to evidence that the valuation approach can capture the breadth of services (market and non-market) and complement one which considers overarching principles plus implementation through local plans and consultation. Second, there is debate about how to develop financing mechanisms for specific services whilst maintaining broader goals; for example, there would appear to be a clear role for an honest broker to ensure parity between habitat or ecosystem champions and stakeholders, and a shared understanding in roles of land uses and habitats in the ecosystem service framework. Third, the research focus of (woodland) ecologists is broadened to consider not just the native, ancient and special. Some particular opportunities include the evidence base for ecosystem functioning, including multiple woodland types and novel ecosystems, different species and different management systems.

Finally, there is a need for ecologists not to suspend their critical faculties just because the ecosystem service tide seems to be flowing in a favourable direction.

References

- Deal, R., Cochrane, B. & LaRocco, G. (2012) Bundling of ecosystem services to increase forestland value and enhance sustainable forest management. *Forest Policy and Economics*, **17**, 69–76.
- Essl, F., Moser, D., Dullinger, S., Mang, T. & Hulme, P.E. (2010) Selection for commercial forestry determines global patterns of alien conifer invasions. *Diversity and Distributions*, **16**, 911–921.
- Forestry Commission (2011) *The UK Forestry Standard*. Forestry Commission, Edinburgh.
- Peterken, G.F. (1981) *Woodland Conservation and Management*. Chapman & Hall, London.
- Quine, C.P. & Humphrey, J.W. (2010) Plantations of exotic tree species in Britain: irrelevant for biodiversity or novel habitat for native species? *Biodiversity Conservation*, **19**, 1503–1512.
- Quine, C.P., Cahalan, C., Hester, A., Humphrey, J., Kirby, K., Moffat, A. & Valatin, G. (2011) *Chapter 8 Woodlands in UK National Ecosystem Assessment Technical Report*. UNEP-WCMC, Cambridge.
- Read, D.J., Freer-Smith, P.H., Morison, J.I.L., Hanley, N., West, C.C. & Snowdon, P.R. (eds.) (2009) *Combating Climate Change – a Role for UK Forests*. The Stationery Office, Edinburgh.
- Rodwell, J.S. & Patterson, G.S. (1994) *Creating New Native Woodland*. Forestry Commission Bulletin 112, HMSO, London.
- Schlaepfer, M.A., Sax, D.F. & Olden, J.D. (2011) The potential conservation value of non-native species. *Conservation Biology*, **25**, 428–437.
- Secretariat of the Convention on Biological Diversity (2004) *The Ecosystem Approach* (CBD Guidelines). Secretariat of the Convention on Biological Diversity, Montreal.
- Spencer, J.W. & Kirby, K.J. (1992) An inventory of ancient woodland for England and Wales. *Biological Conservation*, **62**, 77–93.
- Stroud, D.A., Reed, T.M., Pienkowski, M.W. & Lindsay, R.A. (1987) *Birds, Bogs and Forestry. The Peatlands of Caithness and Sutherland*. Nature Conservancy Council, Peterborough, UK.
- Tsouvalis, J. (2000) *A Critical Geography of Britain's State Forests*. Oxford University Press, Oxford.
- UK National Ecosystem Assessment (2011) *The UK National Ecosystem Assessment Technical Report*. UNEP-WCMC, Cambridge.

Received 7 August 2012; accepted 6 February 2013

Handling Editor: Phil Hulme

Biosketches

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